

09/701057

FORM PTO-1390 (REV 12-29-99)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER <b>44257.830001.000</b>
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
INTERNATIONAL APPLICATION NO. <b>PCT/GB99/01094</b>	INTERNATIONAL FILING DATE <b>April 9, 1999</b>	PRIORITY DATE CLAIMED <b>5/26/98 and 11/13/98</b>	
TITLE OF INVENTION <b>CAP CLOSURE</b>			
APPLICANT(S) FOR DO/EO/US <b>Henning Von Spreckelsen and Peter M. McGeough</b>			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li>6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>			
Items 11. to 16. below concern document(s) or information included:			
<ol style="list-style-type: none"> <li>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</li> <li>14. <input type="checkbox"/> A substitute specification.</li> <li>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>16. <input type="checkbox"/> Other items or information:</li> </ol>			

534 Rec'd PCT/PTO 22 NOV 2000

U.S. APPLICATION NO. (if known, see 37 CFR 1.53)		INTERNATIONAL APPLICATION NO.		ATTORNEY'S FEE/US NUMBER	
09/701057		PCT/GB99/01094		44257.830001.000	
17. <input checked="" type="checkbox"/> The following fees are submitted:				CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):					
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO .....				\$970.00	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO .....				\$840.00	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .....				\$690.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) .....				\$670.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) .....				\$96.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$ 840.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	11 - 20 =	0	X \$18.00	\$ 0	
Independent claims	3 - 3 =	0	X \$78.00	\$ 0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$260.00	\$ 0	
TOTAL OF ABOVE CALCULATIONS =				\$840.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).				\$	
SUBTOTAL =				\$840.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$840.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.23, 3.31). \$40.00 per property				\$ 40.00	
TOTAL FEES ENCLOSED =				\$ 880.00	
				Amount to be:	\$
				refunded	\$
				charged	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$880.00 to cover the above fees is enclosed.					
b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed.					
c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 082623. A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO: 11/22/00					
SIGNATURE: <i>Francis A. Sirr</i>					
NAME: Francis A. Sirr					
REGISTRATION NUMBER: 17,265					

09/701057

534 Rec'd PCT/PTG 22 NOV 2000

Attorney Docket No. 44257.830001.000  
EXPRESS MAIL NO EL539957842US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of \_\_\_\_\_ )  
\_\_\_\_\_ )  
Henning Von Spreckelsen and Peter M. ) Group Art Unit: \_\_\_\_\_  
McGeough )  
\_\_\_\_\_ ) Examiner: \_\_\_\_\_  
Serial No. \_\_\_\_\_ )  
\_\_\_\_\_ )  
Filed: Herewith )  
\_\_\_\_\_ )  
For: CAP CLOSURE )  
\_\_\_\_\_ )

CERTIFICATE OF MAILING BY EXPRESS MAIL

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

The undersigned hereby certifies that the following documents:

1. Transmittal letter for Patent Application
2. Utility Patent Application
3. Executed Combined Declaration and Power of Attorney
4. 4 sheets of formal drawings
5. Preliminary Amendment
6. Recordation Form Cover Sheet PTO 1595 with Executed Assignment and Recording Fee of \$40.00
7. Information Disclosure Statement
8. \$880.00 filing fee
9. Return postcard
10. Certificate of Mailing By Express Mail

relating to the above application, were deposited as "Express Mail", Mailing Label  
No EL539957842US with the United States Postal Service, addressed to Box PCT, the Assistant  
Commissioner for Patents, Washington, D.C., 20231, on November 22, 2000

November 22, 2000  
Date

11/22/00  
Date

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Mailer

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PATENT

Attorney Docket No. 44257.830001.000

EXPRESS MAIL NO. EL539957842US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )  
 )  
Henning Von Spreckelsen and Peter ) Group Art Unit: \_\_\_\_\_  
M. McGeough )  
 ) Examiner: \_\_\_\_\_  
Serial No. \_\_\_\_\_ )  
 )  
Filed: Herewith )  
 )  
For: CAP CLOSURE )  
\_\_\_\_\_ )

PRELIMINARY AMENDMENT

Asst. Commissioner for Patents  
Washington, D.C. 20231

Sir:

Please amend the above-identified patent application as follows.

IN THE SPECIFICATION:

Page 1, between lines 1 and 2, insert --This United States patent application is a national filing from PCT/GB99/01094, international filing date 09 April 1999. PCT/GB99/01094 claims the priority of GB 9811308.7, 26 May 1998, and PCT/GB98/03433, 13 November 1998. The priority of GB 9811308.7, PCT/GB98/03433 and PCT/GB99/01094 are claimed under 35 USC 119 for this United States patent application. --

Page 3, line 9, after "provided" insert --,-- .

Page 5, line 19, after "removed" insert --,-- .

Page 6, line 10, cancel "US-A-24,815,618" and insert --U.S. Patent No. 4,815,618-- .

Page 6, line 16, after "invention" insert --,-- .

Page 8, line 23, after “capacity” insert --,-- .

Page 8, line 24, cancel “Description of a Preferred Embodiment”  
insert --Brief Description of the Drawing-- .

Page 8, line 25, after “understood” insert --,--.

Page 9, line, 6, before “section” insert --partial--.

Page 9, line 10, after “neck” insert --shown in Figure 5--.

Page 9, line 11, after “neck” insert --of Figure 5--.

Page 9, line 12, after “a” insert --frangible--.

Page 9, line 12, cancel “from below” and insert --of Figure 7--.

Page 9, line 13, after “neck” insert --of Figure 5--.

Page 9, line 15, after “cap” insert --of Figure 10--.

Page 9, between lines 15 and 16 insert --Detailed Description of  
the Invention--.

Page 10, line 11, after “parsion” insert --is--.

Page 11, line 14, after “described” insert --in--.

Page 11, line 15, after “lip” insert --,--.

Page 11, line 24, after “the” insert --outer annular flange 28 of--.

Page 11, line 25, cancel “side wall 18” and insert  
--outer annular flange 28--.

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Page 12, line 4, after "located" insert --,--.

Page 13, line 8, after "(not shown)" insert --,--.

Page 15, line 2, cancel "9 and 10" and insert --10 and 11--.

Page 15, line 16, cancel "," and insert --,--.

Page 16, line 10, cancel "spout" and insert --annular side wall--.

Page 17, line 1, after "process" insert --,--.

Page 17, line 16, cancel "body" and insert

--horizontal flange--.

IN THE CLAIMS:

Cancel Claims 12 and 13.

REMARKS

This U.S. patent application is a national filing from PCT/GB99/1094. Enclosed for information only is a copy of the 5-page INTERNATIONAL PRELIMINARY EXAMINATION REPORT (Form PCT/IPEA/409) that was received in that PCT application.

As the Examiner will see, claim 1 was rejected as lacking novelty in view of EP-A-126 575, and claims were rejected as lacking an inventive step in view of DE-A-43 40 553 and EP-A-0 755 971.

An important function of the present invention is to achieve a good seal between a blow-molded bottle (having a tolerance in the order of 0.3mm) and an injection-molded cap (having a tolerance in the order of 0.1 mm) (see for example page 2, lines 3-15 of the present specification).

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In a new, unusual and not-obvious manner, the present invention solves this problem by providing (1) a thin-wall extrusion blow molded bottle, (2) an injection-molded cap, and (3) an injection-molded neck assembly whose open bottom is fused to the bottle and whose open top removably carries the cap.

Additional features of the invention are a foil-type seal that is carried by the open bottom of the neck assembly, and a manually pullable assembly by which this foil-type seal can be removed, thus opening the bottle, including foil-cutting teeth that are carried adjacent to the open bottom of the neck assembly.

Document EP-A-126 575 merely describes a bottle 101 that is made up of a cylindrical center portion 102, a top portion 103 that is friction welded (spin welded) to the top edge of center portion 102, and a bottom section 104 that is friction welded (spin welded) to the bottom edge of center portion 102. In the embodiment of FIG. 7, and after liquid filling of the can body 302, a flat closure top 305 is friction welded in place on the top of body 302, this top 305 including a tear-open tab (see claim 3).

Document DE-A-43 40 553 (D1) (English translation not available) appears to describe a foil 10 that is attached to a pivotable member 20, such that pivoting of member 20 from its FIG. 1 position to its FIG. 2 position causes teeth 17 to cut foil 10.

Document EP-A-0 755 871 (D2) (English translation not available) appears to describe a comparable closure.

Document WO 96/14249 describes a pour-spout 10 that is mounted onto a liquid-filled container without the need to make an opening in the container. Pour-spout 10 includes a membrane seal 20 whose bottom surface is attached to the top surface of a scored portion of the container. When seal 20 is removed by an upward or a downward movement thereof, the scored

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portion of the container is likewise removed. A cap 14 is removably attached to pour spout 10.

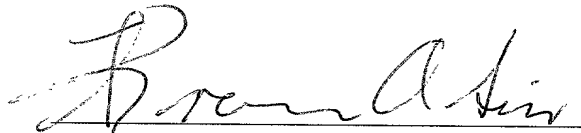
It is respectfully submitted that these documents, where taken solely or in combination, do not anticipate or render obvious the present claimed invention wherein an injection-molded neck assembly has its open bottom fused adjacent to the opening of a thin wall and extrusion blow molded bottle, with an injection-molded cap then being removably mounted to close the open top of the neck assembly.

Request:

Allowance of this amended application is respectfully requested.

Signed this 22 day of November, 2000

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Francis A. Sirr", written over a horizontal line.

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## Cap closure

### Background of the Invention

The present invention relates to fluid packaging.

The present invention particularly relates to packaging using thin-walled extrusion blow  
5 moulded plastics bottles for fluids such as milk, which require to be filled and closed in a resealable manner.

The invention also relates to resealable cap closures for use with plastics bottles or composite material cans, and more specifically to such closures which provide tamper evidence.

10 In the specification that follows problems of packaging milk are specifically addressed. However, it will be appreciated that other pourable fluids such as fruit juice present similar packaging problems. The present invention is, however, only concerned with fluids that are not required to be packed in a pressurised manner. Accordingly, the problems of packaging carbonated drinks are not addressed.

15 The present invention in one aspect is also specifically concerned with types of packaging where the weight of the container is an issue and therefore relates specifically to thin-walled blow moulded plastics bottles.

In another aspect, the invention is concerned with resealable cap closures that reveal when tampering has taken place

### 20 The Technical Background

Conventionally, milk has been packaged in cardboard, gable top packs, which are notoriously difficult to open and result in numerous consumer complaints about milk

spillage and difficulty in pouring. The fibre carton was only suitable for packaging liquids up to a capacity of 1.5 litres.

In order to resolve these problems blow moulded plastics polyethylene bottles have been used. These bottles are provided with resealable caps. The resealable caps are normally injection-moulded items. Since weight is significant in the packaging of fluids such as milk, these caps must also be light in weight. A weight of 2 to 4 g is usually the maximum that can be tolerated.

There is also a fundamental problem in achieving a good seal between a blow moulded bottle neck and an injection moulded plastics cap. This is because the tolerance of the neck is of the order of 0.3 mm whereas the tolerance of an injection-moulded item such as the cap is 0.1 mm. This means that a proportion of caps will not seal tightly when fitted to their necks. For all designs of caps this results in difficulties of fitting on the production line and, for retailers and distributors, leakage problems. The ultimate consumer may also have difficulty in resealing the bottle or opening it in the first place if the cap is over-tight.

A number of designs of injection moulded caps have been developed in an attempt to address these problems. For example, in a cap design known as a valve seal or pliable seal closure, a plug is provided in the cap which pushes into the neck of the bottle and a multiple start thread is provided on the interior wall of the cap skirt. This type of cap provides a double seal. The plug provides the seal against the inner wall of the neck. The second seal is provided by means of an inwardly projecting ridge above the threads on the inner wall of the cap, which seals against the outer wall of the neck. A pliable pull away ring around the lower edge of the cap can provide tamper evidence for this type of cap. With a cap made of low density polyethylene, it is possible to prise off the cap with the ring attached so that this form of tamper evidence is not very secure.

Another design known as the induction heat seal closure (IHS) provides a foil insert seated into the base of the cap. On the production line the filled bottles with caps fitted

When the consumer unscrews the cap the neck of the bottle is still sealed by the foil. This foil seal is pulled off in a separate operation. Severing the seal results in small hairs of the plastics material being raised on the surface of the bottle neck which can inhibit a good seal being formed when the cap is replaced after initial opening. The setting of parameters for the bonding process using an induction heat seal closure is critical in order to achieve a bond which is weak enough to allow the consumer to be able to peel away the foil, yet strong enough to maintain a good primary seal with the container neck. Because the presence of the foil means that no plug can be provided the susceptibility to leakage in the consumer's home is increased as the resealing of the cap is poor. The cap is also relatively expensive as the provision of the peelable foil insert can add as much as 20% to the cost of the container.

15 the milk starts to froth, the rate of filling depends upon the size of the nozzle used to pour the milk into the bottles. The nozzle size is constrained by the dimensions of the neck. For a typical milk container this is 38 mm. Larger necks allow for quicker filling but present greater sealing problems and require larger caps.

than injection stretch blow moulding. In many modern production lines, a blow moulding plant is adjacent the dairy. This allows the bottles to be formed, filled and sealed in a single continuous production process. The most complex stage in blow moulding is balancing each parison and controlling the material distribution. The parison is then inflated against the wall of a temperature regulated mould solidifying to assume the shape of the mould cavity. In one conventional design of blow moulding machine a block of moulds shuttles between an extrusion station and a blowing station. The number of die-heads provided is generally equal to the number of cavities in the block or some fraction thereof. These die-heads are fed by a head manifold that typically results

in an imbalance in the delivery of plastics material to each of the resulting parisons. This process results in difficulties in forming consistently the neck-portion of thin walled containers, achieving at best tolerances of  $\pm 0.3$  mm with repeatable accuracy. To achieve good performance with valve seal closures, it is imperative to form a perfectly

5 round neck-bore with a minimum amount of ovality in both bore and threaded portion. Two processes are known to achieve the above result in multi-cavity blow moulding. They are namely a "pull-up" process, which is the lifting of a blow pin through a shear-steel assembly to cut a round bore in a bottle neck, or a "ram-down" process, which is the forcing downwards of a blow pin into a shear steel assembly. The drawback with

10 pull-up is that the neck component is physically weak in its construction leading to poor sealing with valve seal closures as the bore relaxes over time causing leakage. Ram-down however, gives a very rigid neck but this has a weight disadvantage causing ovality of the neck coupled with added cost of material wastage. Ovality causes poor sealing with valve seal closures. Neither of these two processes is suitable for moulding pour-lip

15 features on bottle-necks. With the pull-up finish it is almost impossible to mould a pour-lip feature and with the ram-down finish, it requires significant amounts of extra material and is almost impossible to mould without significant ovality and imperfections in the bore.

The above processes described relate to moulding machinery manufactured by companies

20 such as Uniloy, Techne and Bekum, for example.

An alternative type of machine made by companies such as Graham Engineering and Uniloy, which is particularly suitable for on-site blow moulding plants, uses a process which is commonly referred to as wheel blow moulding. Unlike the previous processes described, the wheel produces only one parison at a time extruded from a single die-

25 head. The mould blocks are mounted on a rotary wheel structure and pass over the parison closing as the wheel rotates. A needle assembly pierces the parison and inflates the plastics until it solidifies against the wall of the temperature regulated moulds. Wheel blow moulding gives a high level of control in material distribution in containers

produced in this way. The set up time for such a machine is significantly reduced, as only one die-head needs to be set up.

Where the inner wall of the neck provides one part of a seal, it may be necessary to provide a separate finishing station where the neck is either reamed or punch finished.

- 5 The finishing step may produce swarf, which results in the risk that the swarf could enter inside the bottles and make them unsuitable for immediate filling.

- For products such as milk where large quantities are required to be distributed through the retail chain, it is highly desirable to minimise the weight of the packaging. This has resulted in larger containers and thinner walls. Typical wall thicknesses for blow
- 10 moulded high-density polyethylene (HDPE) are 0.4 to 0.6 mm. This results in a 4 pint (2.27 litres) bottle having a weight of around 40 g. Therefore any solution to the technical problems described must not increase the weight of the bottle and preferably would allow weight reduction.

#### Prior Art

- 15 For cardboard cartons it has been proposed to provide a separate spout assembly which is secured to the carton. An example is described in WO-A 96/14249 (Capitol Spouts Inc.). This spout includes a cap and an integral inner membrane seal and is assembled to an outer wall of a filled carton. The container may have a scored portion so that when the inner membrane seal is removed it brings with it the scored portion of the container
- 20 wall creating an opening through which the contents of the container can reach the spout. This assembly is not suitable for use with a plastics container where it would be impractical for the user to tear an opening in a plastics walled container. The cardboard carton will typically have a continuous inner lining. This type of spout must be fitted to the carton prior to filling and is not used for filling the container.
- 25 GB-A-2 108 464 (Container Corporation of America) describes an end closure arrangement wherein a membrane is sandwiched between and used to bond rim portions

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1.

2.

Therefore, although it is known to produce a separate component defining a neck as in GB-A-2 108 464, the possibility of using this approach to solve the long present technical

problems of effective reclosable sealing of thin-walled blow moulded plastics containers for fluids had not hitherto been appreciated and cannot therefore be regarded as obvious.

#### Solution of the Invention

In accordance with the present invention there is provided a thin-walled plastics bottle  
 5 comprising an extrusion blow moulded body and an injection moulded neck and cap assembly adapted to be fused together with the body after the body has been filled with a fluid, wherein the cap is fitted to the neck in order to provide a leak free resealable closure.

This solution has numerous advantages. The neck and cap will fit together in a reliable  
 10 sealing manner as both components are formed by the same manufacturing technique, preferably injection moulding, which means both components will be subject to the same tolerances. The neck and cap assembly can be supplied from a separate factory, which can produce them in hygienic circumstances. Any of the pre-existing cap designs can be employed.

15 The body to which the neck and cap assembly is fitted can have a relatively wide mouth through which it can be filled, thus increasing the filling speed.

In a preferred embodiment of the closure, the cap comprises a cover plate and a depending skirt, and the base has a weakened annular recess which is concealed by the skirt of the cap when the closure is sealed. With this construction, any attempt to prise  
 20 the base from the neck of the bottle results in destruction of the cap closure as the levering force results in the base severing at the weakened recess.

Relative to the prior art defined in Gach which describes a bottle comprising a body having an open mouth, a neck and cap assembly comprising a skirt adapted to engage over the mouth and defining a pour spout and having a pull ring coupled to a removable  
 25 part held within a base of the neck which seats against an upper surface of the mouth; and

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a foil interposed between the surface and the base and fused with both such that removal of the pull ring and removable part removes at least part of the foil and opens the spout; the present invention is characterised in that the removable part comprises an annular flange separated from a remainder of the base by means of a frangible valley defining a plurality of depending teeth each having a saw tooth profile inclined inwardly to a centre of the base such that on removal of the pull ring the foil is torn by the teeth.

The use of an annular flange rather than a disc as in Gach allows the neck assembly to be injection moulded in one piece by means of a mould tool which can be separated along an axis passing through a centre of the pull ring and flange. The saw tooth teeth tear the foil cleanly ensuring that it is removed with the pull ring allowing fluid to flow freely out of the spout.

In addition, the foil is used to seal the mouth at the same time as the neck and cap assembly is fused to the mouth in a single heat sealing operation. This results in more reliable sealing of the filled bottles avoiding any leakage during the distribution and retailing cycle.

The closure described is suitable for use with thin-walled plastics bodies and composite cardboard cans or other containers of any material to which a base of the closure can be fitted. Other aspects and features of the invention are set out in the claims.

The term thin-walled as used herein is intended to refer to wall thicknesses of 2 mm or less and preferably within the range 0.1 mm to 1.0 mm. A container having a wall thickness of less than 0.1 mm is unlikely to have the necessary structural integrity to hold its shape when filled with fluid. For a milk container of up to 6 pints (3.41 litres) capacity a thickness of 0.4 to 0.6 mm is appropriate.

#### Description of a Preferred Embodiment

In order that the invention may be well understood an embodiment thereof will now be



described, by way of example only, with reference to the accompanying drawings, in which:

- Figure 1 shows a side view of a mouth of a first embodiment of a bottle body;
- Figure 2 shows a perspective view of a mouth of the bottle body of Figure 1;
- 5 Figure 3 shows a top plan view of a mouth of the bottle body of Figure 1;
- Figure 4 shows a section through a side wall at a mouth of the bottle body of Figure 1;
- Figure 5 shows a section through a neck and cap assembly assembled to a second embodiment of a bottle body;
- 10 Figure 6 shows a perspective view from below of a neck;
- Figure 7 shows a plan view from below of the neck;
- Figure 8 shows an enlarged view of a portion of the neck from below;
- Figure 9 shows a perspective view from above the neck;
- Figure 10 shows an underside plan view of a cap; and
- 15 Figure 11 shows a section through the cap.

A bottle body 2 has a mouth 4, which is integrally formed in a single blow moulding operation. The remainder of the body shape has not been shown as it may take any suitable form. For example it may be square, rectangular or round in section and may have an integral handle formed as part of the body shape.

- 20 The profile 6 of the mouth is best shown in Figure 4 and comprises a vertical wall 8

adjoining an indented recess 10 which merges into an inwardly directed horizontal seating flange 12. The purpose of the recess 10 is to give the mouth profile more rigidity and resistance to compression when top loaded during the subsequent operations to attach a neck and cap assembly. It is also used to locate a mouth of the neck assembly

5 when applied in the filling process.

The body 2 with its shaped mouth profile 6 is formed by the mould against which a parison of high density polyethylene or other suitable plastics is inflated in any appropriate conventional extrusion blow moulding process. If the blow moulding takes place on a rotary machine then nicks 14 in the flange 12 as shown in Figure 3 will be

10 formed. These are usually removed in second stage trimming by either reaming or punching after any dome of the parison guillotined from the container to leave the open mouth 6. This invention removes the necessity for this trimming and finishing. It is not necessary to remove these or any other irregularities in the internal profile of the mouth for use in the fusing of the neck to the container profile 6.

15 The mouth of the bottle as illustrated in Figure 5 has a modified profile from that shown in the embodiment of the bottle illustrated in Figures 1 to 4. The mouth profile of the bottle shown in Figure 5 defines a narrow shelf 15 around the mouth above the recess 10. This shelf 15 allows a neck of a neck and cap assembly to be perched on the bottle during the assembly process before the neck has been fully engaged with the bottle body.

20 The presence of the shelf 15 allows the bodies with necks perched on them to be moved along an assembly line without the neck and cap assemblies falling off.

A neck 16 is shown in the Figures 5,6,7 and 9. The neck comprises an annular side wall 18 supported on a base 20 which fits to the bottle body and which in this embodiment comprises a flat portion covering the mouth of the bottle and a skirt which couples to the

25 neck profile. It will be appreciated that when the closure is used with other types of container, other designs of base will be needed. For example, the base to be used with a composite container can end may use a flange which projects beyond the flat portion

Table 1. Demographic characteristics of the study population	
Age (years)	65.8 ± 1.2
Gender (male/female)	10/10
Education (years)	12.5 ± 0.5
Occupation (white/blue)	10/10
Marital status (married/divorced/widowed)	10/10/0
Smoking status (smoker/non-smoker)	10/10
Alcohol consumption (yes/no)	10/10
Comorbidities (hypertension/diabetes/cholesterol)	10/10/10
Medication (antihypertensive/antidiabetic/anticholesterol)	10/10/10
Family history (hypertension/diabetes/cholesterol)	10/10/10
Physical activity (yes/no)	10/10
Stress level (low/moderate/high)	10/10/10
Sleep quality (good/poor)	10/10
Depression score (0-10)	2.5 ± 0.5
Anxiety score (0-10)	3.0 ± 0.5
Life satisfaction score (0-10)	7.5 ± 0.5
Health-related quality of life score (0-10)	8.0 ± 0.5
Overall health status (good/fair/poor)	10/10/10
Study duration (months)	12 ± 0.5
Dropouts (yes/no)	0/10
Adherence (yes/no)	10/10
Compliance (yes/no)	10/10
Retention (yes/no)	10/10
Completion (yes/no)	10/10
Follow-up (yes/no)	10/10
Re-evaluation (yes/no)	10/10
Re-assessment (yes/no)	10/10
Re-analysis (yes/no)	10/10
Re-synthesis (yes/no)	10/10
Re-interpretation (yes/no)	10/10
Re-evaluation (yes/no)	10/10
Re-assessment (yes/no)	10/10
Re-analysis (yes/no)	10/10
Re-synthesis (yes/no)	10/10
Re-interpretation (yes/no)	10/10
Re-evaluation (yes/no)	10/10
Re-assessment (yes/no)	10/10
Re-analysis (yes/no)	10/10
Re-synthesis (yes/no)	10/10
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Re-evaluation (yes/no)	10/10
Re-assessment (yes/no)	10/10
Re-analysis (yes/no)	10/10

Table 1. Demographic characteristics of the study population	
Age (years)	65.2 ± 1.2
Gender (male/female)	10/10
Education (years)	12.5 ± 0.5
Occupation	Retired
Marital status	Married
Family size	3.5 ± 0.5
Income (USD/month)	1,200 ± 100
Health status	Good
Smoking status	Non-smoker
Alcohol consumption	Occasional
Exercise frequency	Regular
Stress level	Low
Sleep quality	Good
Dietary habits	Healthy
Medication use	None
Comorbidities	None
Overall health score	85.0 ± 2.0

Table 1. Demographic characteristics of the study population	
Age (years)	65.2 ± 1.2
Gender (male/female)	10/10
Education (years)	12.5 ± 0.5
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Exercise frequency	Regular
Stress level	Low
Sleep quality	Good
Dietary habits	Healthy
Medication use	None
Comorbidities	None
Overall health score	85.0 ± 2.0



projecting rib 46 in order to engage with a recess 10 of the profile 6 of the mouth of the bottle body 2.

In the upper surface and towards the outer edge of the outer flange 28 an annular weakened recess 48 is formed. The recess 48 provides a point of weakness so that if an attempt is made after the container has been assembled to prise off the neck 16 by use of levering action between the skirt 44 and the wall of the bottle 8, the skirt will separate from the flat portion 26 indicating that the closure has been tampered with.

In an alternative embodiment (not shown) the annular side wall 18 could be provided with a shoulder so that the pour spout of the neck which is closed by a cap 50 may be of smaller diameter than the mouth of the bottle body.

The design of the side wall and pour spout of the neck 16 is dependent on the type of cap that will be used to complete the neck and cap assembly. The cap 50 in the illustrated embodiment is of the valve seal type, which provides a push fit. It will be appreciated that the neck can be adapted for use with screw on caps and for this purpose may have a thread or multi-start threads formed in an outer surface of the side wall 18 to engage with a screw thread formed in an inner wall of the co-operating cap.

The cap 50 as shown in Figures 10 and 11 is an injection moulded component comprising a cover plate 52 with a depending inner cylindrical plug 54. The cylindrical plug 54 extends vertically downward from the cover plate 52. An annular bead 56 is formed around an external surface of the plug. The bead 56 engages with the bead 24 on the annular side wall 18 of the neck 16 to retain the cap 50 on the neck. Below the bead 56 the plug wall tapers inwardly to facilitate insertion into the mouth of the neck.

A depending outer skirt 58 is joined to the edge of the cover plate 52. The skirt 58 has an essentially vertical region 60 adjacent the cover plate 52 which merges into a flared region 62. The free edge of the flared region 62 opposite the cover plate 52 aligns itself with the edge of the neck skirt 44 outwardly of the weakened recess 48 so that there is an

unbroken profile of the closed neck and cap assembly. The depth of the skirt 58 is such that the edge just reaches the upper surface of the flat portion 26 of the neck 16 when the cap is fully engaged with the neck 16. The clearance of 0.5 mm is preferred in the neck and cap assemblies before they are assembled to bottle bodies.

- 5 The profile of the flared region 62 allows the skirt to flex when subject to downward pressure applied to the cap during assembly. It will also be appreciated that the alignment of the skirt 58 with an outer edge of the neck assembly ensures that downward forces applied to the cap are transmitted through the skirt 58 to the skirt 44 of the neck assembly into the body of the bottle 12. This minimises the risk of damage to the pour  
10 spout and the valley structure during assembly of the neck and cap assembly and also during resealing of the bottle.

An annular bead 64 is situated on the inside of skirt 58 of the cap close but spaced from the top of the vertical region 60. The purpose of the bead 64 is to provide a seal with the underside of the pour lip 22.

- 15 The cap 50 is snap fitted onto a mouth of the pour spout. It is sufficiently flexible not to deform the pour lip during the sealing and resealing operation. The slightly curved profile of the annular side wall 18 maintains sufficient rigidity which guides the plug of the cap when the cap is snap fitted. With the design illustrated in Figure 5 there are two sealing points between the cap and the neck. The first sealing point is between the  
20 annular bead 64 and an underside of the pour lip. The second sealing point is between the co-operative annular beads 24, 56 on the side wall 18 and the plug 54 respectively. When the cap engages with the neck, the flexing of the annular beads as they come into contact produces an audible click which indicates that a seal has formed and the cap is properly located. This two point sealing is particularly efficient at eliminating the risk of  
25 leaks. Because both the neck assembly and the cap are injection moulded components, they can be moulded accurately. This ensures that a good, repeatable engagement can be provided.

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seal within the cap. Where an aluminium laminate is used small perforations may be provided in the aluminium layer to allow the polymer to pass through during the heat sealing process and thereby form a bond between the flange 12 of the bottle body and the adjacent surface of the base 26 of the neck. The foil 70 is preferably supplied already  
 5 bonded to the base of the neck and cap assembly. The foiled neck and cap assemblies are then delivered to a filling hall.

During the heat sealing of the foil to the lower face of the flat portion 26, there will be a certain flow of plastics material into the valley between the inner and outer flanges 30, 28. The width of the valley is critical, as this flow of material must not submerge the  
 10 teeth 36. During the induction heating the spout 18 also collapses to some extent and the edge of the skirt 58 of the cap 50 will now come into contact with an upper surface of the flat portion 26.

Both the neck and cap are preferably injection moulded plastics components. Since they are both manufactured by the same method to the same tolerances the seal between neck  
 15 and cap will be good. The neck and cap assemblies may be supplied to a bottling plant ready assembled, tested and sterilised.

The details of the injection moulding process and the detailed design of the tool will not be described herein as they will be readily apparent to those skilled in the art.

#### Filling Process

20 The described bottle and neck and cap assembly may be used in various ways in a filling hall of bottling plants. The bottle bodies may be supplied to the plant ready formed but this results in the need to transport large volumes and it is preferable to form the bodies in a blow moulding plant adjacent the dairy so that they can be formed and filled in one continuous production line. The absence of any requirement for further trimming and  
 25 finishing the interior of the mouth of the body makes this design of bottle particularly suitable for such a process.



In a preferred embodiment of the process the bottle bodies are blow moulded using a rotary machine having a series of moulds adapted to pass beneath a single die-head for the supply of a predetermined amount of plastics material to form a parison which is subsequently inflated to form the bodies. Such rotary machines are commercially  
 5 available and require only the modification of the mould to define the required mouth profile 6 instead of a more conventional neck.

The bodies are filled through the mouth with the fluid such as milk.

In aseptic packaging the foil 70 will be sprayed with a sterilising solution such as a water/paracetic acid mixture in order to sterilise the face of the foil which will be  
 10 adjacent the milk in the finished container. Such a sterilising solution is marketed under the trademark OXONIA. Alternative sterilising methods such as irradiation may be employed but are at this time more expensive.

The sterilised and foiled neck and cap assemblies are supplied through a chute to a pick and place mechanism, which orients each neck and cap assembly and places it on a filled  
 15 bottle body. The skirt 44 clips over the profile 6 sandwiching the foil 70 between the two components. In the next step, the neck assembly 16 is bonded to the body 12. Preferably a chute of the pick and place mechanism contains an induction coil so that as each assembly is pressed onto the body induction heating is applied to bond the foil to the body. To form an effective bond some pressure may be required to hold the body and  
 20 neck firmly together during this step. The induction heating and bonding may alternatively be carried out at a separate station downstream of the pick and place mechanism. ENERCON AHLBRANDT supplies suitable induction heating machines.

Rotation generated friction heating could also be used to fuse the body and neck and cap assembly without the presence of an intervening foil.

### Opening Process

When the user receives the filled bottle, the first step is to remove the cap 50 by lifting it at the tab 66 to release the seal around the pour lip and to lever the cap off. This exposes the pull ring 42. The user inserts a finger into the centre of the ring and pulls the ring  
 5 upward about an axis defined in the plane of the base 20 perpendicular to the legs 40. This produces a rotational movement that stretches the foil 70 against the longer outer face of the saw tooth profiled teeth 36. The points of the teeth facilitate tearing of the foil 70 as the pull ring is lifted. The tear in the foil proceeds in a simultaneous clockwise and counter-clockwise direction until the tears meet opposite the legs 40. The lifting of  
 10 the ring also causes the bridges 34 in the frangible region 32 to break. That part of the foil 70 that is fused to the flange 30 is pulled away and discarded with it.

The fluid may then be poured out of the exposed opening over the pour lip 22. When the user wishes to re-seal the bottle the cap 50 is replaced by simply pushing the plug 54 into the mouth of the neck and pressing down until the beads 24, 56 interlock. This  
 15 sealing is signified by an audible snap.

### Modifications of the cap closure

It will be appreciated that the same design of cap closure can be used with containers other than bottles, for example composite cartons. In such an application, the base 20 would need to be adapted to fit to the composite carton end. This may require an  
 20 annular flange instead of the depending skirt 44. The flange could then be fused or otherwise connected to the carton. In all other respects the structure of a closure would remain the same.

## Claims

1. A thin-walled plastics bottle comprising an extrusion blow moulded body and an injection moulded neck and cap assembly adapted to be fused together with the body after the body has been filled with a fluid, wherein the cap is fitted to the neck in order to provide a leak free resealable closure.
2. A closure for use with a thin-walled plastics bottle as claimed in claim 1 or another type of container having a body, wherein a foil is interposed between the body and the neck and cap assembly, and the neck and cap assembly comprises a base fitted to the body, a removable annular flange connected to a pull ring and secured to the foil, the removable annular flange being separated from the base by a frangible region, and a plurality of depending teeth each having a saw tooth profile inclined inwardly to a centre of the base formed in the base in or adjacent to the frangible region such that on removal of the pull ring the foil is torn by the teeth.
3. A closure as claimed in claim 2, wherein the cap comprises a cover plate and a depending skirt and the base has a weakened annular recess (48), which is concealed by a skirt of the cap, when the closure is sealed.
4. A closure as claimed in claim 2, wherein the pull ring is supported above the annular flange (30) by means of a pair of adjacent spaced legs (40) to promote symmetrical tearing of the foil
5. A closure as claimed in claim 2, wherein the foil is a tearable aluminium foil coated with a fusible polymer material on both sides.
6. A bottle comprising a body (2) having an open mouth (4), a neck and cap assembly comprising a skirt (44) adapted to engage over the

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mouth and defining a pour spout (18) and having a pull ring (42) coupled to a removable part (30) held within a base (20) of the neck which seats against an upper surface (12) of the mouth; and

a foil (70) interposed between the surface (12) and the base (20) and fused with both such that removal of the pull ring (42) and removable part (30) removes at least part of the foil (70) and opens the spout (18);

characterised in that the removable part comprises an annular flange (30) separated from a remainder of the base (20) by means of a frangible valley (32) defining a plurality of depending teeth (36) each having a saw tooth profile inclined inwardly to a centre of the base such that on removal of the pull ring the foil (70) is torn by the teeth (36).

7. A process for bottling fluid comprising the steps of:

extrusion blow moulding thin-walled bottle bodies having open mouths;  
filling said bottle bodies;

fitting an injection moulded neck and cap assembly having a base of the neck covered by a foil and sized to correspond to the open mouth of the bottle body to each filled bottle body;

heat sealing the bottle bodies to the foil of the neck and cap assemblies.

8. A process as claimed in claim 7, further comprising sterilising the foil prior to the fitting step.

9. A process as claimed in claim 7, wherein the bottle bodies are blow moulded using a rotary machine having a series of moulds adapted to pass beneath a single die-head for the supply of a predetermined amount of plastics material to form a parison which is subsequently inflated to form said body.

10. A process as claimed in claim 10, wherein the bottle body leaving the mould is passed directly to a filling station.

## ABSTRACT

A sealing arrangement for a plastic bottle includes a blow-molded bottle having a body and a mouth that includes an opening, an injection molded neck that includes a continuous wall that defines a top wall-opening and a bottom wall-opening. The top wall-opening provides a pour spout for liquid contained within the body of the bottle. The bottom wall-opening is fused to the mouth of the bottle so as to surround the bottle's opening. A removable flange is located generally within the bottom wall-opening and a frangible region connects the flange to the wall. A foil is secured to a side of the flange that is generally adjacent to the bottom wall-opening, and the foil is adapted to close the bottom wall-opening. A plurality of foil-cutting teeth are carried by the wall generally adjacent to the bottom wall-opening, generally adjacent to the side of the flange and generally adjacent to the foil. A pull member is secured to the flange. Manual operation of the pull member separates the flange from the wall, as at least a portion of the foil is cut by the teeth. An injection-molded cap removably closes the top wall-opening. The wall includes a weakened portion that will break upon an attempt to physically remove the wall from the bottle. The cap includes a cover plate that covers the top wall-opening and a skirt that extends from the cover plate to cover the weakened portion of the wall.

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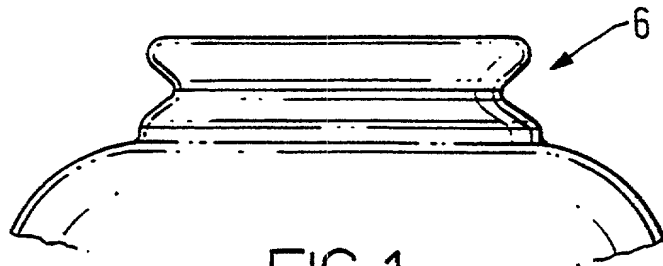


FIG. 1

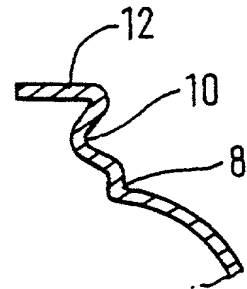


FIG. 4

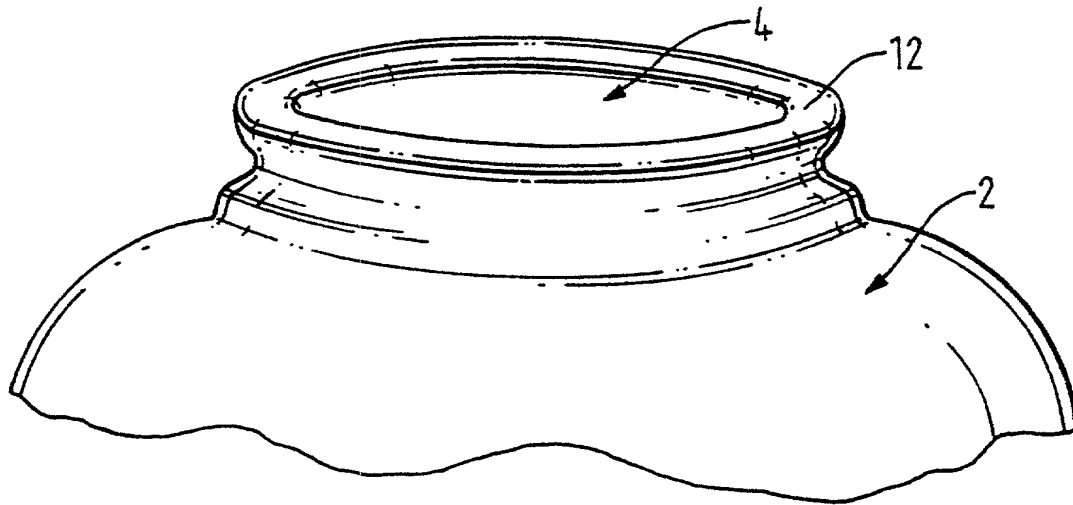


FIG. 2

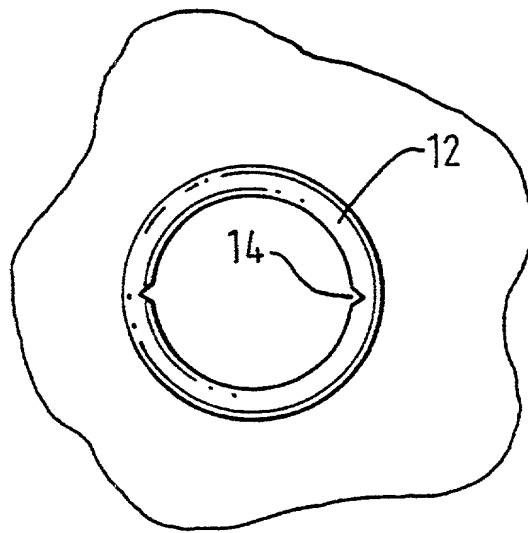


FIG. 3

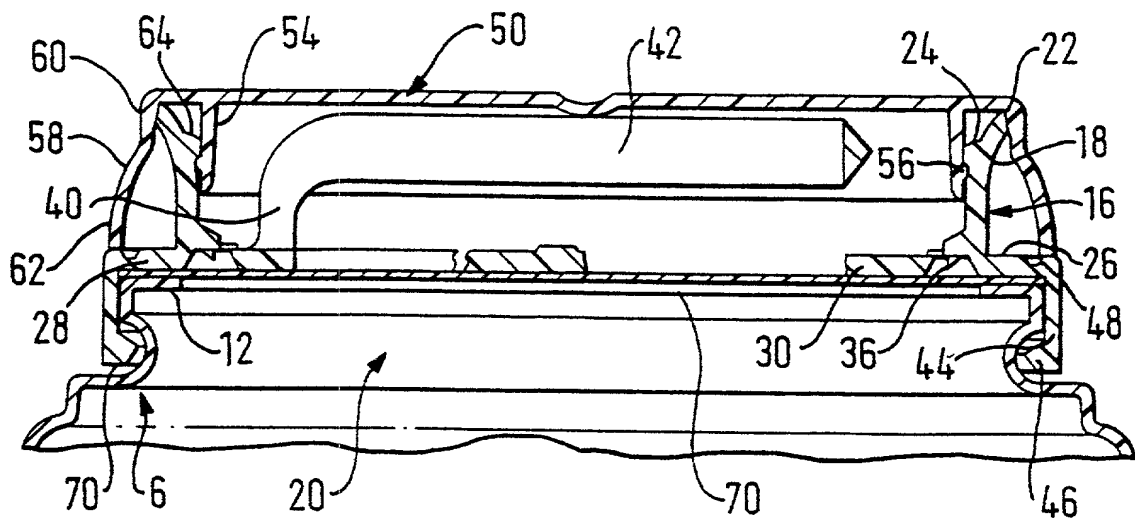


FIG. 5

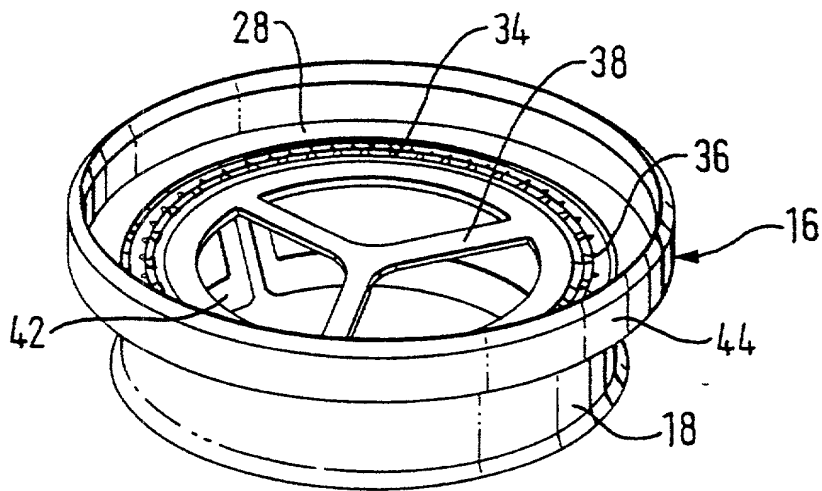


FIG. 6

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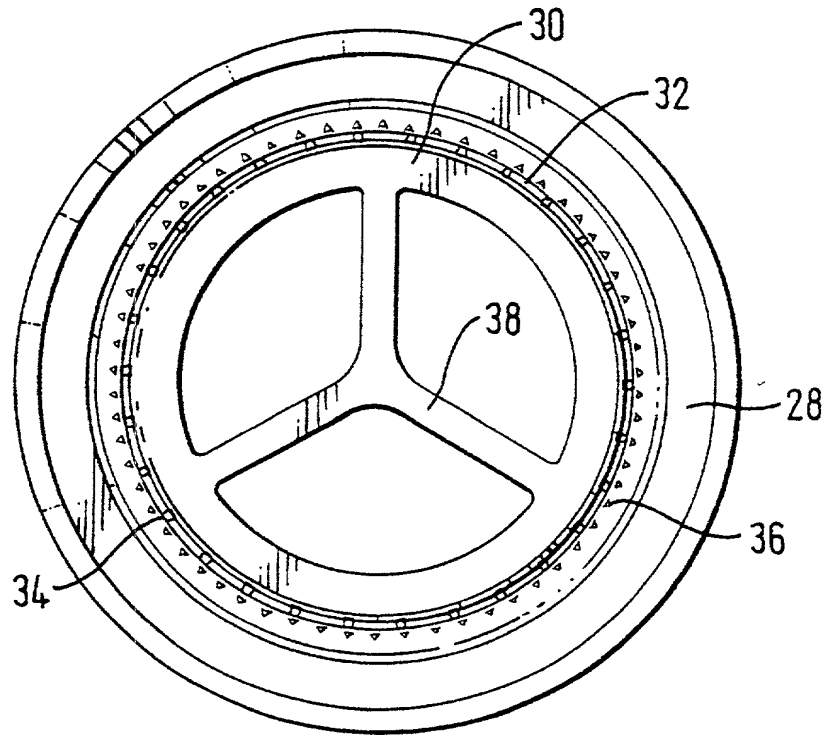


FIG. 7

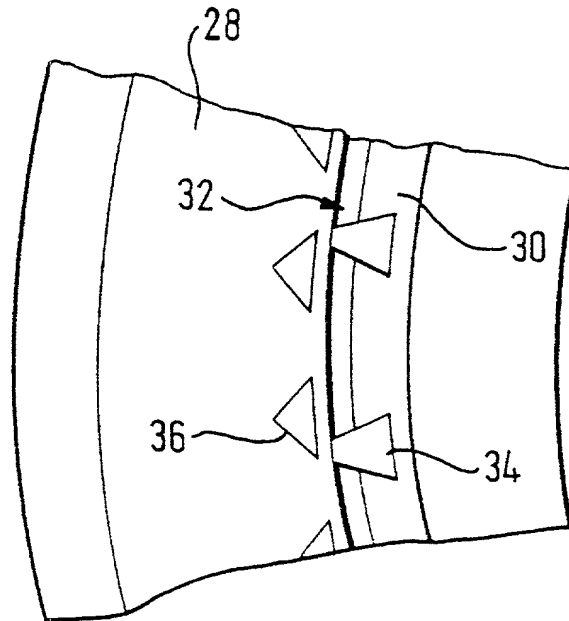


FIG. 8



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FIG. 9

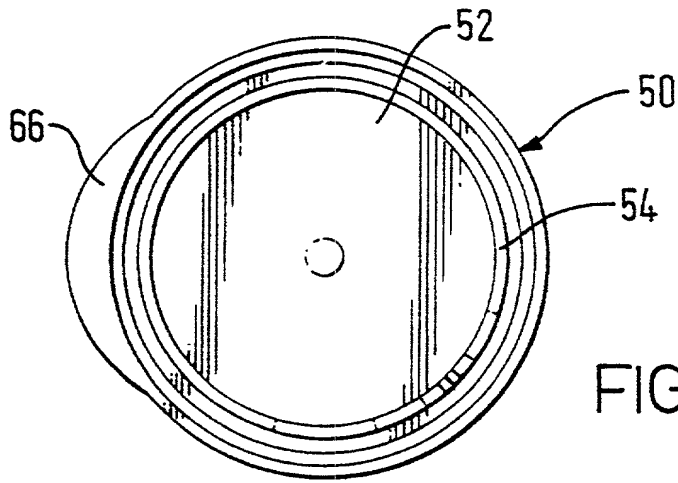
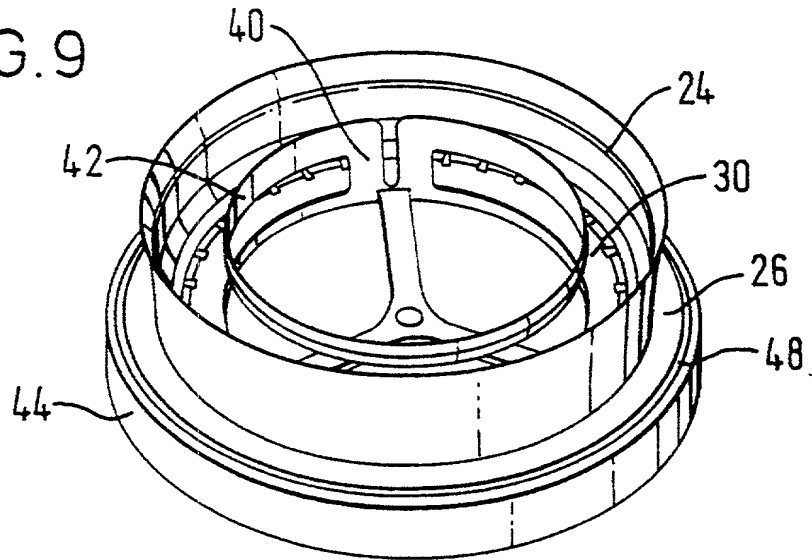


FIG. 10

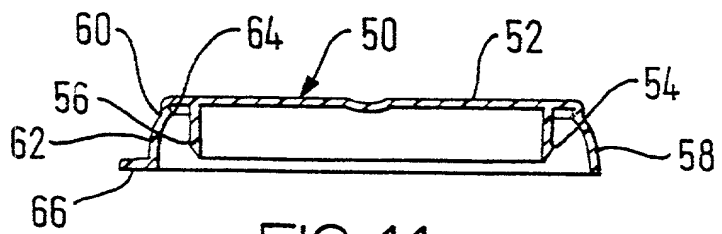


FIG. 11

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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE  
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UTILITY OR DESIGN  
PATENT APPLICATION**☒ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing

Attorney Docket Number

First Named Inventor

HENNING VON SPRECKELSEN

**COMPLETE IF KNOWN**

Application Number

Filing Date

Group Art Unit

Examiner Name

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CAP CLOSURE

(Title of the invention)

the specification of which

☒ is attached hereto  
OR☐ was filed on (MM/DD/YYYY)

as United States Application Number or PCT International

Application Number

and was amended on (MM/DD/YYYY)

(if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35 United States Code §119 (a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365 (a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
PCT/GB99/01094 9811308.7	GREAT BRITAIN	11/13/1998	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	GREAT BRITAIN	05/26/1998	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority sheet attached hereto:

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.

(Page 1 of 5)

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(January 1997)

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## DECLARATION

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s), or §365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority sheet attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Name	Registration Number	Name	Registration Number
Hancock, Earl C.	19,472		
Sirr, Francis A.	17,265		
Kelly, Robert	33,922		
Kinnear, Brian	43,717		

☐ Additional registered practitioner(s) named on a supplemental sheet attached hereto.

Direct all correspondence to:

Name	Holland & Hart LLP		
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		Fax	303-473-2720
ZIP	80201-8749		

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:

☐ A petition has been filed for this unsigned inventor

Given Name	HENNING	Middle Initial		Family Name	VON SPRECKELSEN	Suffix e.g. Jr.	
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Inventor's Signature	Henning von Spreckelsen	Date	13 November 2000
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Residence: City	SURREY	State		Country	ENGLAND	Citizenship	GERMAN
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Post Office Address	LITTLE GAWTON, HORSELL VALE, WOKING		
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Post Office Address			
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City	SURREY	State		Zip	GU21 4QU	Country	ENGLAND
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☒ Additional inventors are being named on supplemental sheet(s) attached hereto

Please type a plus sign (+) inside this box → ☒

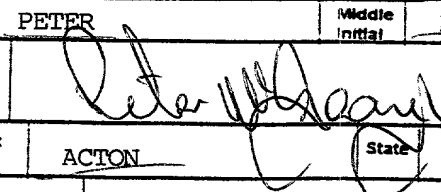
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## DECLARATION

ADDITIONAL INVENTOR(S)  
Supplemental Sheet

Name of Additional Joint Inventor, if any:				<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name	PETER	Middle Initial	M.	Family Name	MCGEOUGH	Suffix	
Inventor's Signature					Date	15 November 2000	
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City	LONDON	State		Zip	W3 6EW	Country	ENGLAND
Name of Additional Joint Inventor, if any:				<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name		Middle Initial		Family Name		Suffix	
Inventor's Signature					Date		
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		Zip		Country	
Name of Additional Joint Inventor, if any:				<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name		Middle Initial		Family Name		Suffix	
Inventor's Signature					Date		
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		Zip		Country	
Name of Additional Joint Inventor, if any:				<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name		Middle Initial		Family Name		Suffix	
Inventor's Signature					Date		
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		Zip		Country	
Name of Additional Joint Inventor, if any:				<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name		Middle Initial		Family Name		Suffix	
Inventor's Signature					Date		
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		Zip		Country	

☐ Additional inventors are being named on supplemental sheet(s) attached hereto

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**PRIORITY DATA**  
**(Supplemental Sheet)**

[illegible]

Application Number	Filing Date (MM/DD/YYYY)

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

1997-1998		1998-1999		1999-2000		2000-2001		2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008		2008-2009		2009-2010		2010-2011		2011-2012		2012-2013		2013-2014		2014-2015		2015-2016		2016-2017		2017-2018		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2023-2024		2024-2025		2025-2026		2026-2027		2027-2028		2028-2029		2029-2030		2030-2031		2031-2032		2032-2033		2033-2034		2034-2035		2035-2036		2036-2037		2037-2038		2038-2039		2039-2040		2040-2041		2041-2042		2042-2043		2043-2044		2044-2045		2045-2046		2046-2047		2047-2048		2048-2049		2049-2050		2050-2051		2051-2052		2052-2053		2053-2054		2054-2055		2055-2056		2056-2057		2057-2058		2058-2059		2059-2060		2060-2061		2061-2062		2062-2063		2063-2064		2064-2065		2065-2066		2066-2067		2067-2068		2068-2069		2069-2070		2070-2071		2071-2072		2072-2073		2073-2074		2074-2075		2075-2076		2076-2077		2077-2078		2078-2079		2079-2080		2080-2081		2081-2082		2082-2083		2083-2084		2084-2085		2085-2086		2086-2087		2087-2088		2088-2089		2089-2090		2090-2091		2091-2092		2092-2093		2093-2094		2094-2095		2095-2096		2096-2097		2097-2098		2098-2099		2099-2100		2100-2101		2101-2102		2102-2103		2103-2104		2104-2105		2105-2106		2106-2107		2107-2108		2108-2109		2109-2110		2110-2111		2111-2112		2112-2113		2113-2114		2114-2115		2115-2116		2116-2117		2117-2118		2118-2119		2119-2120		2120-2121		2121-2122		2122-2123		2123-2124		2124-2125		2125-2126		2126-2127		2127-2128		2128-2129		2129-2130		2130-2131		2131-2132		2132-2133		2133-2134		2134-2135		2135-2136		2136-2137		2137-2138		2138-2139		2139-2140		2140-2141		2141-2142		2142-2143		2143-2144		2144-2145		2145-2146		2146-2147		2147-2148		2148-2149		2149-2150		2150-2151		2151-2152		2152-2153		2153-2154		2154-2155		2155-2156		2156-2157		2157-2158		2158-2159		2159-2160		2160-2161		2161-2162		2162-2163		2163-2164		2164-2165		2165-2166		2166-2167		2167-2168		2168-2169		2169-2170		2170-2171		2171-2172		2172-2173		2173-2174		2174-2175		2175-2176		2176-2177		2177-2178		2178-2179		2179-2180		2180-2181		2181-2182		2182-2183		2183-2184		2184-2185		2185-2186		2186-2187		2187-2188		2188-2189		2189-2190		2190-2191		2191-2192		2192-2193		2193-2194		2194-2195		2195-2196		2196-2197		2197-2198		2198-2199		2199-2200		2200-2201		2201-2202		2202-2203		2203-2204		2204-2205		2205-2206		2206-2207		2207-2208		2208-2209		2209-2210		2210-2211		2211-2212		2212-2213		2213-2214		2214-2215		2215-2216		2216-2217		2217-2218		2218-2219		2219-2220		2220-2221		2221-2222		2222-2223		2223-2224	
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